Radiation use efficiency, N accumulation and biomass production of high-yielding rice in aerobic culture

AUTHOR(S):

Katsura, Keisuke; Okami, Midori; Mizunuma, Hiroaki; Kato, Yoichiro

CITATION:

Katsura, Keisuke ...[et al]. Radiation use efficiency, N accumulation and biomass production of high-yielding rice in aerobic culture. Field Crops Research 2010, 117(1): 81-89

ISSUE DATE:

2010-05-08

URL:

http://hdl.handle.net/2433/109967

Table 1. N accumulation rate (kgN ha^{-1} d^{-1}) during the reproductive stage (from 9-week after sowing to heading) and ripening stage for each cultivar.

	Reproductive stage				Ripening stage			
	Tokyo		Osaka		Tokyo		Osaka	
	2007	2008	2007	2008	2007	2008	2007	2008
Aerobic								
Akihikari	2.56	3.19	4.08	2.71	0.78	0.79	1.46	2.29
IRAT109	2.58	3.49	3.44	3.27	0.63	0.86	1.33	1.20
Lemont	2.38	2.26	3.07	2.89	0.97	1.44	1.09	0.91
Takanari	2.69	4.04	2.88	3.23	0.71	1.25	1.19	0.37
Average	**2.55**	**3.25**	**3.36**	**3.02**	**0.77**	**1.08**	**1.27**	**1.19**
Flooded								
Akihikari	2.99	2.58	2.53	3.82	0.02	1.02	0.93	1.20
IRAT109	2.71	2.90	1.32	2.20	0.28	0.20	1.33	1.48
Lemont	2.22	1.89	1.55	1.77	0.77	0.59	0.60	1.12
Takanari	3.50	2.54	2.66	2.40	1.26	2.00	0.71	1.38
Average	**2.86**	**2.48**	**2.01**	**2.55**	**0.58**	**0.95**	**0.89**	**1.30**
LSD (0.05)								
Water regime	0.27	0.31	0.50	0.34	NS	NS	0.24	NS
Cultivar	0.38	0.44	0.71	0.48	NS	0.29	0.34	0.30
Cultivar × Water	NS	NS	NS	0.68	NS	0.41	NS	0.42

Table 2. Aboveground biomass at maturity, growth duration, incident and intercepted radiation, fraction of radiation intercepted, and radiation use efficiency at Tokyo in 2007 and 2008.

	Aboveground biomass at maturity ($t\ ha^{-1}$)	Growth duration[a] (days)	Incident radiation[b] ($\times 10^3 MJ$)	Intercepted radiation[b] ($\times 10^3 MJ$)	Fraction of radiation intercepted[b]	Radiation use efficiency[b] ($g\ MJ^{-1}$)
2007						
Aerobic						
Akihikari	13.2	137	1.67	1.02	0.61	1.33
IRAT109	15.0	147	1.76	1.19	0.68	1.34
Lemont	15.6	161	1.90	1.28	0.67	1.24
Takanari	16.1	171	2.00	1.30	0.65	1.30
Average	**15.0**	**154**	**1.83**	**1.20**	**0.653**	**1.30**
Flooded						
Akihikari	13.7	137	1.67	1.03	0.61	1.39
IRAT109	13.3	147	1.76	1.11	0.63	1.29
Lemont	13.1	161	1.90	1.23	0.65	1.13
Takanari	23.5	168	1.99	1.37	0.69	1.68
Average	**15.9**	**153**	**1.83**	**1.19**	**0.647**	**1.37**
LSD (0.05)						
Water regime	0.4			0.01	0.006	0.03
Cultivar	0.6			0.02	0.01	0.04
Cultivar × Water	0.8			0.02	0.01	0.06
2008						
Aerobic						
Akihikari	15.1	145	1.72	1.08	0.63	1.43
IRAT109	17.8	145	1.72	1.20	0.70	1.50
Lemont	17.4	159	1.87	1.29	0.69	1.35
Takanari	23.6	169	1.98	1.37	0.69	1.72
Average	**18.5**	**155**	**1.82**	**1.23**	**0.68**	**1.50**
Flooded						
Akihikari	15.1	138	1.64	1.06	0.65	1.47
IRAT109	13.3	142	1.70	1.12	0.66	1.32
Lemont	14.0	157	1.84	1.20	0.65	1.21
Takanari	20.7	162	1.90	1.34	0.70	1.50
Average	**15.8**	**150**	**1.77**	**1.18**	**0.67**	**1.37**
LSD (0.05)						
Water regime	0.5			0.01	0.01	0.05
Cultivar	0.7			0.02	0.01	0.07
Cultivar × Water	1.0			0.02	0.01	0.10

a Values from sowing to maturity.

b Values from transplanting to maturity

Table 3. Aboveground biomass at maturity, growth duration, incident and intercepted radiation, fraction of radiation intercepted, and radiation use efficiency at Osaka in 2007 and 2008.

	Aboveground biomass at maturity ($t\ ha^{-1}$)	Growth duration[a] (days)	Incident radiation[b] ($\times 10^3 MJ$)	Intercepted radiation[b] ($\times 10^3 MJ$)	Fraction of radiation intercepted[b]	Radiation use efficiency[b] ($g\ MJ^{-1}$)
2007						
Aerobic						
Akihikari	15.3	124	1.80	1.16	0.64	1.42
IRAT109	17.5	134	1.98	1.54	0.78	1.24
Lemont	17.5	148	2.17	1.70	0.78	1.13
Takanari	21.7	155	2.28	1.69	0.74	1.28
Average	**18.0**	**140**	**2.06**	**1.52**	**0.737**	**1.27**
Flooded						
Akihikari	14.2	116	1.68	1.09	0.65	1.40
IRAT109	13.1	126	1.85	1.21	0.65	1.20
Lemont	12.6	137	2.06	1.38	0.67	1.06
Takanari	18.9	142	2.13	1.54	0.72	1.31
Average	**14.7**	**130**	**1.93**	**1.31**	**0.674**	**1.24**
LSD (0.05)						
Water regime	0.7			0.04	0.023	NS
Cultivar	1.0			0.06	0.03	0.06
Cultivar × Water	1.5			0.09	0.05	NS
2008						
Aerobic						
Akihikari	15.2	132	1.99	1.13	0.57	1.34
IRAT109	16.7	135	2.03	1.26	0.62	1.38
Lemont	16.1	142	2.12	1.36	0.64	1.28
Takanari	20.8	166	2.43	1.68	0.69	1.27
Average	**17.2**	**144**	**2.14**	**1.36**	**0.63**	**1.32**
Flooded						
Akihikari	14.0	120	1.78	1.21	0.68	1.26
IRAT109	13.9	126	1.88	1.28	0.68	1.18
Lemont	13.5	138	2.08	1.44	0.69	1.05
Takanari	19.5	137	2.08	1.52	0.73	1.33
Average	**15.2**	**130**	**1.95**	**1.36**	**0.70**	**1.20**
LSD (0.05)						
Water regime	0.7			NS	0.03	0.07
Cultivar	1.0			0.08	0.04	0.09
Cultivar × Water	NS			0.12	NS	0.13

a Values from sowing to maturity.
b Values from transplanting to maturity

Table 4. The parameters of *a* and *b* for the Eq. (1) (*critical N%* = *a TDW* $^{-b}$) for rice grown in aerobic and flooded culture.

	Logarithm of *a*	*a*	*b*
Tokyo			
Aerobic	1.24 ±0.114	3.47	0.36 ±0.050
Flooded	1.09 ±0.129	2.98	0.34 ±0.058
Osaka			
Aerobic	1.03 ±0.104	2.80	0.28 ±0.046
Flooded	0.99 ±0.116	2.69	0.36 ±0.054
Sheehy et al. (1998)	1.64	5.18	0.52

Values followed by ± represent 95% confidence limits.